

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Applicant :** Raymond A. Neff  
**Serial No. :** 10/606,825  
**Filed :** June 26, 2003  
**Atty. No. :** 12148  
**Title :** VISCOELASTIC POLYURETHANE FOAM

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**Art Unit :** 1796  
**Examiner :** John M. Cooney

**BRIEF ON APPEAL**

**Mail Stop Appeal Brief - Patents**  
**Commissioner of Patents**  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

Dear Sir:

Subsequent to the filing of the Notice of Appeal on November 20, 2007, Applicant now submits a brief in support of the appeal in response to the Final Rejection set forth in the Office Action dated July 26, 2007. Only a single copy of this Appeal Brief is being submitted in accordance with 37 C.F.R. §41.37 and this Appeal Brief is accompanied by the required fee under §41.20(b)(2).

**Real Party in Interest**

The inventor assigned this application to BASF Corporation as evidenced by an assignment recorded at reel 014243, frame 0877.

**Related Appeals and Interferences**

There are no related appeals or interferences.

**Status of Claims**

Claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 are attached hereto in the Claims Appendix. Claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 stand finally rejected under 35 U.S.C. §103(a) and are the subject of this appeal.

**Status of Amendments**

All amendments have been entered and are reflected in the claims in the Claims Appendix.

**Summary of Claimed Subject Matter**

Claim 1 claims a viscoelastic polyurethane foam. The viscoelastic polyurethane foam of the subject invention has a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75 and a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot (page 6, lines 5-15; page 12, lines 4-6; Figures 1 and 2). The viscoelastic polyurethane foam comprises a reaction product of an isocyanate component, an isocyanate-reactive component, and a chain extender (page 6, lines 24-26). The isocyanate-reactive component comprises a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95% (page 9, lines 14-16). The isocyanate component and the isocyanate-reactive component are reacted at an isocyanate index of from 80 to 105 (page 7, lines 7-14; page 10, lines 16-18; page 16, lines 1-6; page 16, lines 11-13; Figures 1 and 2).

Claim 1 also claims a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular

weight of from 25 to 250. The chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam (page 9, 26-30; page 10, lines 1-2; page 10, lines 10-18, page 12, lines 4-16; page 16, lines 1-6; page 16, lines 11-13; Figures 1 and 2).

Claim 48 claims a method of forming a viscoelastic polyurethane foam (page 12, lines 17-20). The method comprises the steps of providing an isocyanate component substantially free of flame retardant (page 12, line 19; page 17, line 9) and providing an isocyanate-reactive component comprising a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95% (page 9, lines 14-16). Claim 48 further claims providing a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular weight of from 25 to 250. The chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam (page 9, 26-30; page 10, lines 1-2; page 10, lines 10-18, page 12, lines 4-16; page 16, lines 1-6; page 16, lines 11-13; Figures 1 and 2). The isocyanate component, the isocyanate-reactive component, and the chain extender are reacted at an isocyanate index of from 80 to 105 (page 7, lines 7-14; page 10, lines 16-18; page 16, lines 1-6; page 16, lines 11-13; Figures 1 and 2) to form the foam having a tan delta peak of from 0.40 to 1.75 and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot (page 6, lines 5-15 and page 12, lines 4-6).

Claim 48 also claims adjusting the amount of the chain extender to provide the foam with a glass transition temperature of from 5 to 65 degrees Celsius corresponding to a use temperature of the foam (page 10, lines 10-18; Figures 1 and 2).

**Grounds of Rejection to be Reviewed on Appeal**

Rejection of claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 as unpatentable under 35 U.S.C. §103(a) over Hager et al. (United States Patent No. 6,391,935).

Rejection of claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 as unpatentable under 35 U.S.C. §103(a) over Lutter et al. (United States Patent No. 5,420,170).

Rejection of claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 as unpatentable under 35 U.S.C. §103(a) over Bleys (United States Patent No. 5,968,993)

**Argument**

The Examiner has not established the requisite *prima facie* case of obviousness in relation to claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58. To establish a *prima facie* case of obviousness, three basic criteria must be met. The requirement that these three criteria be established remains even after the Supreme Court decided *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. at 1734, 82 USPQ2d at 1391, as addressed below. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the prior art reference (or references when combined) must teach or suggest all the claim limitations. See Manual of Patent Examining Procedure (MPEP) § 2143.

Applicant submitted a Declaration under 37 C.F.R. §1.132 from one highly skilled in the art of polyurethane formulation on May 30, 2006 and has included a copy in the Evidence

Appendix for the convenience of the Board. The Declaration sets forth the results of various viscoelastic polyurethane foams formed according to the subject invention having results that are attributable to the specific claim limitations present in claims 1 and 48. Further, the Declaration sets forth sample foams prepared in accordance with the references relied upon by the Examiner and addresses the impropriety and inoperability of modifying such references, which modifications do not arrive at the subject invention as claimed. It is well settled that all of the competent rebuttal evidence taken as a whole should be weighed against the evidence supporting the *prima facie* case. *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984).

Applicant addresses each of the independent claims, claims 1 and 48, separately below for each of the above Ground of Rejections.

**Bleys (United States Patent No. 5,968,993)**

Referring to the §103 rejection based upon Bleys, the Examiner states that Bleys discloses preparations of polyurethane foams prepared from isocyanates, polyols, and chain extenders that have densities as claimed. Specifically, the Examiner cited Example 3 of Bleys that produces a microcellular elastomeric polyurethane foam having a density of 420 kg/m<sup>3</sup>, or 26.2 pounds per cubic foot. Further, the Examiner contends that Bleys discloses preferred densities of less than 600 kg/m<sup>3</sup>. The Examiner then contends it would have been obvious for one having ordinary skill in the art to vary the amounts of the blowing agents to arrive at Applicant's claims.

Claim 1

Claim 1 recites a viscoelastic polyurethane foam comprising a reaction product of an isocyanate component and an isocyanate-reactive component comprising *a flexible polyol and an ethylene-oxide rich polyol* having an ethylene-oxide group content of from 40 to 95%. The isocyanate component and the isocyanate-reactive component are reacted at *an isocyanate index of from 80 to 105*. The viscoelastic polyurethane foam also includes a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular weight of from 25 to 250. The chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam and the foam has the *glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75* and a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot.

Applicants submit that the Examiner is relying on the improper use of hindsight in reaching the conclusion of obviousness. As the Examiner is well aware, the question of obviousness is resolved on the basis of the *Graham* factors.<sup>1</sup> As set forth by the *KSR* court, and as clearly explained in *Ex parte Hewett*<sup>2</sup>, the analysis of these factors follows a “functional approach” and must resolve “whether the improvement is more than the predictable use of prior art elements according to their established functions.”<sup>3</sup> When analyzing these factors, the Examiner should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.<sup>4</sup>

<sup>1</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966). See also *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. at 1734, 82 USPQ2d at 1391

<sup>2</sup> The Applicant acknowledges that this case is not precedential. However, this does not mean that the statement of the law cannot be considered by the Examiner and/or the Board. See Appeal 2006-2827; App. No. 09/883,893

<sup>3</sup> See *KSR*, 127 S.Ct. at 1742, 82 USPQ2d at 1396.

<sup>4</sup> See *Graham*, 383 U.S. at 36, 86 S.Ct. 684; *KSR*, 127 S.Ct. at 1742, 82 USPQ2d at 1397.

Claim 1 claims an isocyanate-reactive component having a *specific* formulation, a chain extender having *specific* characteristics, i.e., backbone chain and molecular weight, and used in a *specific* amount, and a *specific* isocyanate index to produce a viscoelastic polyurethane foam having *specific* performance characteristics. As discussed in paragraphs [0045] and [0047], it was experimentally learned that increasing the chain extender amounts and the isocyanate index, a desired increase in the glass transition temperature of the viscoelastic polyurethane foam could be achieved. However, it was also experimentally learned that increasing the isocyanate index cause the viscoelastic polyurethane foam to shrink which is not desirable. It was further experimentally learned that increasing the isocyanate index would decrease the tan delta peak.

Thus, the inventors were able to achieve the desired glass transition temperature of from 5 to 65 degrees Celsius and the desire tan delta peak of from 0.40 to 1.75 by controlling the elements discussed above. It is respectfully submitted that such a feature was not a known result-effective variable as merely alluded to, *without support*, by the Examiner in Bleys. Such an unsupported conclusion is evidence of impermissible use of hindsight and proves that the Examiner is using the Applicants specification as a road map to find the individual elements in the prior art, such as Bleys. However, even the Examiner has been unable to find all the elements in Bleys or the prior art and relies upon his own, undocumented knowledge to fill in the gaps in the prior art.

Applicants have even submitted a Declaration to further illustrate the distinction between the claimed invention and the prior art relied upon by the Examiner. Referring to the Declaration submitted under 37 C.F.R. §1.132, the Declaration addresses the impropriety of modifying Bleys when viewed as a whole and without using impermissible hindsight and

the inoperability when modified as the Examiner suggests. Specifically, Bleys is directed toward microcellular elastomeric polyurethane foams, *which does not even exhibit viscoelastic properties*. Bleys requires the microcellular elastomeric polyurethane foam to have a Shore A hardness of at least 85 (see col. 3, lines 23-29). Shore hardness is a measure of the resistance of material to indentation with an indenter, such as a 3 spring-loaded indenter. The higher the number, the greater the resistance. Typically, Shore A hardness ranges from about 20 to about 95. Illustrative materials that fall within this range include printing rolls, door seals, solid truck tires, abrasive-handling pads, and non-spark hammers. As made clear by the Declaration, viscoelastic polyurethane foams are flexible and, as such do not have a Shore A hardness falling within this range, if at all. Since Bleys is directed toward microcellular elastomeric polyurethane foams having a Shore A hardness of at least 85, one of ordinary skill in the art would not look to Bleys when manufacturing viscoelastic polyurethane foams.

Bleys does not disclose, teach, or suggest, an isocyanate-reactive component comprising *a flexible polyol and an ethylene-oxide rich polyol* having an ethylene-oxide group content of from 40 to 95%. The Examiner relies upon his own knowledge to provide for the omitted limitation. Bleys also does not disclose, teach, or suggest, the microcellular elastomeric polyurethane foams having a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75. Again, the Examiner relies on his own knowledge for the omitted limitation.

Bleys does not disclose any known result-effective variable that could be optimized as merely suggested by the Examiner. The Examiner merely provides rhetoric that discovering an optimum value of a result effective variable requires only routine skill in the

art.

The Applicants respectfully submit that the Examiner has misapplied the principle of optimization of known result-effective variables to establish *prima facie* obviousness in the present analysis. An evaluation of the obviousness of the invention as a whole requires looking "not only to the subject matter which is literally recited in the claim in question (the ratio value) but also to those properties of the subject matter which are inherent in the subject matter *and* are disclosed in the specification." *In re Antonie*, 559 F.2d at 619, 195 U.S.P.Q. at 8.

In particular, with regard to the glass transition temperature and tan delta peak of the viscoelastic polyurethane foam, the Applicants respectfully submit that the choice of the specific elements having specific characteristics and in specific amounts does not amount to optimization of a known result-effect variable. It is well known that where the prior art has not recognized the "result-effective" capability of a particular invention parameter, such as the connections between the amount of chain extender to the resultant glass transition temperature and tan delta peak, no expectation would exist that optimizing the parameter would successfully yield the desired improvement. The Examiner fails to disclose any result-effective variable disclosed in Bleys that corresponds to any of the limitations from claim 1 that are omitted in the prior art.

Accordingly, Bleys does not disclose, teach, or suggest each and every limitation present in claim 1 and there is no teaching or suggestion to modify Bleys as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 1 is believed to be allowable.

Claims 4-5, 7-18, 20-24,

Claims 4, 5, 7-18, and 20-24, which depend directly or indirectly from claim 1, are also believed to be allowable in view of Bleys.

Claim 48

Claim 48 recites a method of forming a viscoelastic polyurethane foam. The method comprises the steps of providing an isocyanate component substantially free of flame retardant, providing an isocyanate-reactive component comprising *a flexible polyol and an ethylene-oxide rich polyol* having an ethylene-oxide group content of from 40 to 95%, and providing a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular weight of from 25 to 250. The chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam. The method also includes reacting the isocyanate component, the isocyanate-reactive component, and the chain extender *at an isocyanate index of from 80 to 105* to form the foam having *a tan delta peak of from 0.40 to 1.75* and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot. The method further includes *adjusting the amount of the chain extender* to provide the foam with *a glass transition temperature of from 5 to 65 degrees Celsius* corresponding to a use temperature of the foam.

Bleys does not disclose, teach, or suggest, the novel and unique step of adjusting the amount of the chain extender to provide the foam with a glass transition temperature of from 5 to 65 degrees Celsius corresponding to a use temperature of the foam. Bleys is silent as to glass transition temperature of its microcellular elastomeric polyurethane foam and to any connection between the presence of the chain extender and the glass transition temperature.

Further, Bleys does not disclose, teach, or suggest, reacting the isocyanate component, the isocyanate-reactive component, and the chain extender at an isocyanate index of from 80 to 105 to form the foam having a tan delta peak of from 0.40 to 1.75 and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot. Even though Bleys discloses the microcellular elastomeric polyurethane foam having a density of less than 37.5 pcf, Bleys is silent as to a tan delta peak of the microcellular elastomeric polyurethane foam.

Again, the Examiner merely provides rhetoric that discovering an optimum value of a result effective variable requires only routine skill in the art and fails to identify any result-effective variable disclosed in Bleys that corresponds to any of the numerous limitations from claim 48 that are omitted in the prior art.

Accordingly, Bleys does not disclose, teach, or suggest, each and every limitation present in claim 48 and there is no teaching or suggestion to modify Bleys as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 48 is believed to be allowable.

Claims 51-52, 54-58

Claims 51, 52, and 54-61, which depend directly or indirectly from claim 48, are also believed to be allowable in view of Bleys.

**Hager et al. (United States Patent No. 6,391,935)**

Referring to the §103 rejection based upon Hager et al., the Examiner states that Hager et al. discloses preparations of polyurethane foams prepared from isocyanates, polyols, and chain extenders having densities claimed. The Examiner also states that Hager et al. differs from the claimed invention in that the chain extenders are not particularly employed

in the amounts claimed. The Examiner contends that since the amount of chain extender may be varied for the purposes of controlling polymer build-up, it would have been obvious to vary the amount of chain extender to arrive at the claimed invention for the purpose of controlling polymer build-up. Please note, there is no basis for such a contention by the Examiner in Hager et al., as described below.

As an initial matter, the Examiner's reliance on *Titanium Metals* is misplaced and the rejection should be withdrawn because the Examiner contends that *Titanium Metals* allows for "similar" properties. As set forth in MPEP §2144.05,

Similarly, a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the *same* properties. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) (Court held as proper a rejection of a claim directed to an alloy of "having 0.8% nickel, 0.3% molybdenum, up to 0.1% iron, balance titanium" as obvious over a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, balance titanium and 0.94% nickel, 0.31% molybdenum, balance titanium.) [emphasis added].

Thus, *Titanium Metals* holds that the *same* properties are to have been expected. The properties disclosed in Hager et al. are not the same properties disclosed in the subject application. Hager et al. is directed toward a unique isocyanate-reactive mixture that includes a specific monol that was key to widening processing conditions, whereas the subject invention is directed toward the choice of the specific elements having specific characteristics and in specific amounts to provide the glass transition temperature and tan delta peak of the viscoelastic polyurethane foam. Thus, based on *Titanium Metals* alone, the Examiner's rejection relying on Hager et al. should be withdrawn.

Claim 1

To summarize, claim 1 recites the isocyanate-reactive component comprising a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95%. The isocyanate component and the isocyanate-reactive component are reacted at *an isocyanate index of from 80 to 105*. Further, the chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam and the foam has the *glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75* and a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot.

Referring again to the Declaration under 37 C.F.R. §1.132, the Declaration addresses the impropriety of modifying Hager et al. and the inoperability when modified as the Examiner suggests. Hager et al. is silent as to the glass transition temperature of the viscoelastic polyurethane foam formed therein. As such, the Declaration compared foams prepared based upon the teachings of Hager et al. to the subject invention as claimed.

Specifically, the foams were prepared in accordance with Examples 16 and 19 having the chain extender present in an amount of 2 parts by weight. The resultant foams had a glass transition temperature of less than 0 °C. It is well settled that evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art, can rebut *prima facie* obviousness. “Evidence that a compound is unexpectedly superior in one of a spectrum of common properties . . . can be enough to rebut a *prima facie* case of obviousness.” No set number of examples of superiority is required. *In re Chupp*, 816 F.2d 643, 646, 2 USPQ2d 1437, 1439 (Fed. Cir. 1987).

In comparison with the first set of examples set forth in the Declaration, even when

the subject invention has the same or less chain extender than disclosed in Hager et al., the viscoelastic polyurethane has a glass transition temperature greater than 0 °C. There is no recognition within Hager et al. that the glass transition temperature can be adjusted by manipulating the amount of the chain extender in the amount claimed. In fact, Hager et al. teaches away from using the chain extender in the amounts claimed. Hager et al. discloses that the chain extender may *optionally* be used and if used in only used in a minor proportion, i.e., less than 5 wt%. Even though the Examiner contends that the chain extender may be used for increasing polymer build-up, *nowhere* is such a purpose disclosed in Hager et al. As such, Hager et al. does not disclose, teach, or suggest, a viscoelastic polyurethane foam having a glass transition temperature of from 5 to 65 degrees Celsius *and* a tan delta peak of from 0.40 to 1.75 *and* a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot.

Referring to unexpected results, Mr. Raymond Neff, a Ph.D Chemical Engineer, who has worked in polyurethane chemistry for 15 years, stated in paragraph 6 that even though lower amounts of chain extenders are known, the resultant effects on the glass transition temperature of the viscoelastic polyurethane foam when used in higher amounts was previously unexpected. Further, the foams formed in accordance with the prior art references did not produce the claimed glass transition temperatures and tan delta peak as claimed.

Hager et al. does not disclose any known result-effective variable that could be optimized as merely suggested by the Examiner. Once again, the Examiner merely provides rhetoric that discovering an optimum value of a result effective variable requires only routine skill in the art.

The Applicants respectfully submit that the Examiner has misapplied the principle of optimization of known result-effective variables to establish *prima facie* obviousness in the present analysis as discussed above with regard to Bleys. In particular, with regard to the glass transition temperature and tan delta peak of the viscoelastic polyurethane foam, the Applicants respectfully submit that the choice of the *specific* elements having *specific* characteristics and in *specific* amounts does not amount to optimization of a known result-effect variable. It is well known that where the prior art has not recognized the "result-effective" capability of a particular invention parameter, no expectation would exist that optimizing the parameter would successfully yield the desired improvement. The Examiner fails to disclose any result-effective variable disclosed in Hager et al. that corresponds to any of the limitations from claim 1 that are omitted in the prior art.

Accordingly, Hager et al. does not disclose, teach, or suggest, each and every limitation present in claim 1 and there is no teaching or suggestion to modify Hager et al. as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 1 is believed to be allowable.

Claims 4, 5, 7-18, and 20-24

Claims 4, 5, 7-18, and 20-24, which depend directly or indirectly from claim 1, are also believed to be allowable.

Claim 48

To reiterate, claim 48 recites providing an isocyanate-reactive component comprising a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95% and reacting the isocyanate component, the isocyanate-reactive component, and the chain extender *at an isocyanate index of from 80 to 105* to form the foam having *a tan delta peak of from 0.40 to 1.75* and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot. The method further includes *adjusting the amount of the chain extender* to provide the foam with *a glass transition temperature of from 5 to 65 degrees Celsius* corresponding to a use temperature of the foam.

Hager et al. does not disclose, teach, or suggest, the novel and unique step of adjusting the amount of the chain extender to provide the foam with a glass transition temperature of from 5 to 65 degrees Celsius corresponding to a use temperature of the foam. Hager et al. is silent as to glass transition temperature of the viscoelastic polyurethane foam and to any connection between the presence of the chain extender and the glass transition temperature. The Declaration submitted herewith compared foams prepared according to the disclosure of Hager et al. and the resultant foams had glass transition temperatures of less than 0 °C as discussed above. One of ordinary skill in the art, upon reviewing Hager et al., would not be so motivated to adjust the amount of the chain extender within the claimed ranges to arrive at a viscoelastic polyurethane foam having a glass transition temperature of from 5 to 65 °C.

Again, the Examiner merely provides rhetoric that discovering an optimum value of a result effective variable requires only routine skill in the art and fails to identify any result-

effective variable disclosed in Hager et al. that corresponds to any of the numerous limitations from claim 48 that are omitted in the prior art.

Accordingly, Hager et al. does not disclose, teach, or suggest, each and every limitation present in claim 48 and there is no teaching or suggestion to modify Hager et al. as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 48 is believed to be allowable.

Claims 51, 52, and 54-61

Claims 51, 52, and 54-61, which depend directly or indirectly from claim 48, are also believed to be allowable.

**Lutter et al. (United States Patent No. 5,420,170)**

Referring to the §103 rejection based upon Lutter et al., the Examiner states that Lutter et al. discloses preparations of polyurethane foams prepared from isocyanates, polyols, and chain extenders having densities claimed. The Examiner also states that Lutter et al. recites variation of amounts of chain extenders that overlap with the claimed ranges. The Examiner contends that since the amount of chain extender may be varied for the purposes of controlling polymer build-up, it would have been obvious to vary the amount of chain extender to arrive at the claimed invention for the purpose of controlling polymer build-up.

As an initial matter, the Examiner's reliance on *Titanium Metals* is misplaced and the rejection should be withdrawn because the Examiner contends that *Titanium Metals* allows for "similar" properties. As set forth in MPEP §2144.05,

Similarly, a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one

skilled in the art would have expected them to have the *same* properties. Titanium Metals Corp. of America v. Banner, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) (Court held as proper a rejection of a claim directed to an alloy of "having 0.8% nickel, 0.3% molybdenum, up to 0.1% iron, balance titanium" as obvious over a reference disclosing alloys of 0.75% nickel, 0.25% molybdenum, balance titanium and 0.94% nickel, 0.31% molybdenum, balance titanium.) [emphasis added].

Thus, *Titanium Metals* holds that the *same* properties are to have been expected. The properties disclosed in Lutter et al. are not the same properties disclosed in the subject application. Lutter et al. is directed toward a viscoelastic polyurethane foams used for sound dampening in structures that is based upon a polyoxyalkylene-polyol mixture of *specially* structured polyoxypropylene-polyoxyethylene polyols, whereas the subject invention is directed toward the choice of the *specific* elements having *specific* characteristics and in *specific* amounts to provide the claimed glass transition temperature and tan delta peak of the viscoelastic polyurethane foam. Thus, based on *Titanium Metals* alone, the Examiner's rejection relying on Lutter et al. should be withdrawn.

Claim 1

Claim 1 recites a viscoelastic polyurethane foam having the *glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75* and a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot and using the chain extender in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam.

Referring again to the Declaration under 37 C.F.R. §1.132, the Declaration addresses the impropriety of modifying Lutter et al and the inoperability of modifying Lutter et al. as the Examiner suggests. Lutter et al. is silent as to the glass transition temperature of the

viscoelastic polyurethane foam formed therein. As such, the Declaration compared foams prepared based upon the teachings of Lutter et al. with those of the subject invention.

Specifically, the foams were prepared in accordance with Example 6 having the chain extender present in an amount of 6 parts by weight. The resultant foam had a glass transition temperature of 52 °C. Foams having such a high glass transition temperature become rigid and no longer have viscoelastic properties, as set forth in the Declaration. Further, based upon the findings presented in the Declaration and in view of the subject invention, increasing the amount of the chain extender would *further increase* the glass transition temperature resulting in the foam becoming more rigid, i.e., beyond claimed results of the subject application. Therefore, one of ordinary skill in the art, without relying upon impermissible hindsight, would not be motivated to increase the amount of chain extender to arrive at the claimed invention based upon the disclosure of Lutter et al. Evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art, can rebut *prima facie* obviousness. “Evidence that a compound is unexpectedly superior in one of a spectrum of common properties . . . can be enough to rebut a *prima facie* case of obviousness.” No set number of examples of superiority is required. *In re Chupp*, 816 F.2d 643, 646, 2 USPQ2d 1437, 1439 (Fed. Cir. 1987). Further, there is no disclosure, teaching, or suggestion of adjusting the amount of the chain extender to have the glass transition temperature coincide with the use temperature of the foam.

In comparison with the first set of examples set forth in the Declaration, even when the subject invention has a higher amount of chain extender than the examples of Lutter et al., the viscoelastic polyurethane has a glass transition temperature lower than 52 °C. As

such, Lutter et al. does not disclose, teach, or suggest, the viscoelastic polyurethane foam as claimed.

Referring to unexpected results, Mr. Raymond Neff, a Ph.D Chemical Engineer, who has worked in polyurethane chemistry for 15 years, stated in paragraph 6 that even though lower amounts of chain extenders are known, the resultant effects on the glass transition temperature of the viscoelastic polyurethane foam when used in higher amounts was previously unexpected. Further, the foams formed in accordance with the prior art references did not produce the claimed glass transition temperatures and tan delta peak as claimed.

The Applicants respectfully submit that the Examiner has misapplied the principle of optimization of known result-effective variables to establish *prima facie* obviousness in the present analysis as discussed above with regard to Bleys. In particular, with regard to the glass transition temperature and tan delta peak of the viscoelastic polyurethane foam, the Applicants respectfully submit that the choice of the *specific* elements having *specific* characteristics and in *specific* amounts does not amount to optimization of a known result-effect variable. It is well known that where the prior art has not recognized the "result-effective" capability of a particular invention parameter, no expectation would exist that optimizing the parameter would successfully yield the desired improvement. The Examiner fails to disclose any result-effective variable disclosed in Lutter et al. that corresponds to any of the limitations from claim 1 that are omitted in the prior art.

Accordingly, Lutter et al. does not disclose, teach, or suggest, each and every limitation present in claim 1 and there is no teaching or suggestion to modify Lutter et al. as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 1 is believed to

be allowable.

Claims 4, 5, 7-18, and 20-24

Claims 4, 5, 7-18, and 20-24, which depend directly or indirectly from claim 1, are also believed to be allowable.

Claim 48

Claim 48 recites the viscoelastic polyurethane foam is formed by reacting the isocyanate component, the isocyanate-reactive component, and the chain extender *at an isocyanate index of from 80 to 105* to form the foam having *a tan delta peak of from 0.40 to 1.75* and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot. The method further includes *adjusting the amount of the chain extender* to provide the foam with *a glass transition temperature of from 5 to 65 degrees Celsius* corresponding to a use temperature of the foam.

Lutter et al. does not disclose, teach, or suggest, the novel and unique step of adjusting the amount of the chain extender to provide the foam with a glass transition temperature of from 5 to 65 degrees Celsius corresponding to a use temperature of the foam. Lutter et al. is silent as to glass transition temperature of the viscoelastic polyurethane foam and to any connection between the presence of the chain extender and the glass transition temperature. The Declaration submitted herewith analyzed foams prepared according to the disclosure of Hager et al. and the resultant foam had a glass transition temperature of 52 °C. One of ordinary skill in the art, upon reviewing Lutter et al., would not be so motivated to adjust the amount of the chain extender within the claimed ranges to arrive at a viscoelastic

polyurethane foam having a glass transition temperature of from 5 to 65 °C. As discussed above in connection with claim 1, one of ordinary skill in the art, without relying upon impermissible hindsight, would not be motivated to increase the amount of chain extender to arrive at the claimed invention based upon the disclosure of Lutter et al. As set forth in the Declaration, the foams formed according to Lutter et al. have an relatively high glass transition temperature when the chain extender is present at 6 parts by weight. In accordance with the claimed invention and based upon the findings of the subject application, increasing the amount of chain extender would further increase the chain extender resulting in the viscoelastic foam becoming to brittle and not having the specific and claimed properties.

Again, the Examiner merely provides rhetoric that discovering an optimum value of a result effective variable requires only routine skill in the art and fails to identify any result-effective variable disclosed in Lutter et al. that corresponds to any of the numerous limitations from claim 48 that are omitted in the prior art.

Accordingly, Lutter et al. does not disclose, teach, or suggest, each and every limitation present in claim 48 and there is no teaching or suggestion to modify Lutter et al. as the Examiner suggests. Therefore, the §103 rejection is overcome and claim 48 is believed to be allowable.

Claims 51, 52, and 54-61

Claims 51, 52, and 54-61, which depend directly or indirectly from claim 48, are also believed to be allowable.

Closing

For the reasons set forth above, the rejections of Claims 1, 4-5, 7-18, 20-24, 48, 51-52, and 54-58 under 35 U.S.C. §103(a) must be reversed.

Respectfully submitted,  
**HOWARD & HOWARD ATTORNEYS, P.C.**

January 22, 2008  
Date

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KKH/at

**CLAIMS APPENDIX**

1. **(Previously Presented)** A viscoelastic polyurethane foam comprising a reaction product of:

an isocyanate component;

an isocyanate-reactive component comprising a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95%;

said isocyanate component and said isocyanate-reactive component reacted at an isocyanate index of from 80 to 105;

a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular weight of from 25 to 250, wherein said chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of said foam; and

said foam having a glass transition temperature of from 5 to 65 degrees Celsius and a tan delta peak of from 0.40 to 1.75 and a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot.

2. **(Cancelled).**

3. **(Cancelled).**

4. **(Previously Presented)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender is used in an amount of from 7 to 15 parts by weight based on 100 parts by weight of said foam.

5. **(Original)** A viscoelastic polyurethane foam as set forth in claim 4 wherein said chain extender has a weight-average molecular weight of less than 100.

6. **(Cancelled).**

7. **(Previously Presented)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender is a diol having hydroxyl groups as said isocyanate-reactive groups.

8. **(Original)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said chain extender is further defined as having from two to six carbon atoms.

9. **(Original)** A viscoelastic polyurethane foam as set forth in claim 8 wherein said chain extender is selected from at least one of 1,4-butanediol, 1,3-butanediol, 2,3-butanediol, 1,2-butanediol, 1,3-propylene glycol, and 1,5-pentanediol.

10. **(Previously presented)** A viscoelastic polyurethane foam as set forth in claim 8 wherein said chain extender is selected from at least one of ethylene glycol, diethylene glycol, and polyethylene glycols having a weight-average molecular weight of up to 200.

11. **(Previously presented)** A viscoelastic polyurethane foam as set forth in claim 8 wherein said foam has a glass transition temperature of from 15 to 35 degrees Celsius and a tan delta peak of from 0.9 to 1.5.

12. **(Original)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said isocyanate component is further defined as:

pure diphenylmethane diisocyanate in an amount of from 50 to 99 parts by weight based on 100 parts of said isocyanate component; and

polymeric diphenylmethane diisocyanate in an amount from 1 to 50 parts by weight based on 100 parts of said isocyanate component.

13. **(Original)** A viscoelastic polyurethane foam as set forth in claim 12 wherein said pure diphenylmethane diisocyanate is further defined as:

diphenylmethane-2,4'-diisocyanate in an amount of from 1 to 45 parts by weight based on 100 parts of said pure diphenylmethane diisocyanate; and

diphenylmethane-4,4'-diisocyanate in an amount from 55 to 99 parts by weight based on 100 parts of said pure diphenylmethane diisocyanate.

14. **(Original)** A viscoelastic polyurethane foam as set forth in claim 13 wherein said isocyanate component is further defined as an isocyanate-terminated prepolymer.

15. **(Previously Presented)** A viscoelastic polyurethane foam as set forth in claim 14 wherein said prepolymer comprises a reaction product of an isocyanate and a polyol having a weight-average molecular weight greater than 1,000, said polyol being used in an amount of from 1 to 20 parts by weight based on 100 parts of said isocyanate component.

16. **(Original)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a cross-linker in an amount of from 2 to 18 parts by weight based on 100 parts by weight of said foam.

17. **(Original)** A viscoelastic polyurethane foam as set forth in claim 16 wherein said cross-linker is further defined as being an amine-based cross-linker.

18. **(Original)** A viscoelastic polyurethane foam as set forth in claim 17 wherein said amine-based cross-linker is selected from at least one of triethanolamine, diethanolamine, ethylene diamine and alkoxylation product thereof having a hydroxyl number of greater than 250.

19. **(Cancelled)**

20. **(Previously Presented)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said isocyanate-reactive component has a hydroxyl number of from 20 to 200 mg KOH per gram of said isocyanate-reactive component.

21. **(Original)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a monol in an amount of from 1 to 15 parts by weight based on 100 parts by weight of said foam.

22. **(Original)** A viscoelastic polyurethane foam as set forth in claim 21 wherein said monol is selected from at least one of benzyl alcohol, 2,2-dimethyl-1,3-dioxolane-4-methanol, and alcohol ethoxylate.

23. **(Original)** A viscoelastic polyurethane foam as set forth in claim 1 wherein said reaction product further comprises a cell opener having at least one of a paraffinic, cyclic, and aromatic hydrocarbon chain and is present in an amount of from 1 to 15 parts by weight based on 100 parts by weight of said foam.

24. **(Original)** A viscoelastic polyurethane foam as set forth in claim 23 wherein said cell opener is mineral oil.

**Claims 25-47 (Cancelled)**

48. **(Previously Presented)** A method of forming a viscoelastic polyurethane foam comprising the steps of:

providing an isocyanate component substantially free of flame retardant;

providing an isocyanate-reactive component comprising a flexible polyol and an ethylene-oxide rich polyol having an ethylene-oxide group content of from 40 to 95%;

providing a chain extender having a backbone chain with from two to eight carbon atoms and having two isocyanate-reactive groups and a weight-average molecular

weight of from 25 to 250, wherein the chain extender is used in an amount of from 7 to 30 parts by weight based on 100 parts by weight of the foam;

reacting the isocyanate component, the isocyanate-reactive component, and the chain extender at an isocyanate index of from 80 to 105 to form the foam having a tan delta peak of from 0.40 to 1.75 and having a density of from 2.5 pounds per cubic foot to 25 pounds per cubic foot; and

adjusting the amount of the chain extender to provide the foam with a glass transition temperature of from 5 to 65 degrees Celsius corresponding to a use temperature of the foam.

49. **(Cancelled).**

50 **(Cancelled).**

51. **(Previously Presented)** A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender in an amount of from 7 to 15 parts by weight based on 100 parts by weight of the foam.

52. **(Original)** A method as set forth in claim 51 wherein the step of providing the chain extender is further defined as providing the chain extender having a weight-average molecular weight of less than 100.

53. **(Cancelled).**

54. **(Previously Presented)** A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender as a diol having hydroxyl groups as the isocyanate-reactive groups.

55. **(Original)** A method as set forth in claim 48 wherein the step of providing the chain extender is further defined as providing the chain extender having from two to six carbon atoms.

56. **(Original)** A method as set forth in claim 55 wherein the step of providing the chain extender is further defined as providing the chain extender selected from at least one of 1,4-butanediol, 1,3-butanediol, 2,3-butanediol, 1,2-butanediol, 1,3-propylene glycol, and 1,5-pentanediol.

57. **(Previously presented)** A method as set forth in claim 55 wherein the step of providing the chain extender is further defined as providing the chain extender selected from at least one of ethylene glycol, diethylene glycol, and polyethylene glycols having a weight-average molecular weight of up to 200.

58. **(Previously presented)** A method as set forth in claim 55 wherein the step of reacting the isocyanate component, the isocyanate-reactive component, and the chain extender forms the foam having a glass transition temperature of from 15 to 35 degrees Celsius and a tan delta peak of from 0.9 to 1.5.

Claims 59-61 **(Cancelled)**

**Appln. No.: 10/606,825**  
**Art Unit: 1796**

**EVIDENCE APPENDIX**

EXHIBIT A: Declaration under 37 C.F.R. §1.132

**Appln. No.: 10/606,825**  
**Art Unit: 1796**

**EXHIBIT A**

**DECLARATION UNDER 37 C.F.R. § 1.132**

I, Raymond Neff, hereby state that:

1. I am a citizen of the United States.

2. I am currently employed as a Senior Research Chemist for BASF Corporation of Wyandotte, MI. I have worked in the field of polyurethane chemistry for 15 years and I have been employed by BASF Corporation since 1997 and I am a person highly skilled in the art of polyurethane formulation. I earned a Bachelor of Science degree in Chemical Engineering from the University of Illinois in 1990, and a Ph.D in Chemical Engineering from the University of Minnesota in 1995. My Ph.D. thesis was titled "Reactive Processing of Flexible Polyurethane Foam," and was advised by Professor Christopher Macosko, a renowned scientist in the field of polyurethanes. I have co-authored 6 peer-reviewed journal articles and 1 textbook chapter mostly in this field. In addition, I have made 6 presentations at the Society of Plastics Industry, API, and Polyurethane Foam Association polyurethane conferences, receiving one best paper award. Currently, I am serving on the Editorial Review Board for the Journal of Cellular Plastics, which publishes a substantial portion of its articles on the subject of polyurethanes.

3. I am a co-inventor of the following related co-pending applications:

(1) Applicant: Neff et al.  
Serial No.: 10/606,825  
Filed: June 26, 2003  
Atty. No: 12148  
Title: Viscoelastic Polyurethane Foam  
Art Unit: 1711  
Examiner: Cooney, John M.

(2) Applicant: Apichatachutapan et al.  
Serial No.: 10/607,555  
Filed: June 26, 2003  
Atty. No: 12164  
Title: Viscoelastic Polyurethane Foam  
Art Unit: 1711  
Examiner: Cooney, John M.

(3) Applicant: Neff et al.  
Serial No.: 10/916,241  
Filed: August 11, 2004  
Atty. No: 12252  
Title: Viscoelastic Polyurethane Foam  
Art Unit: 1711  
Examiner: Cooney, John M.

4. The subject Declaration sets forth a series of experiments and data conducted by the Declarant with regard to the above applications (1), (2), (3), to the Examples disclosed in the above applications (1), (2), (3), and to the cited prior art. The most significant results of these experiments are summarized immediately below. The results are set forth in greater detail in Paragraphs 11, 16, and 17.

	Chain Extender, pbw	Tg (°C)
(1) Examples 7-12	7.5 - 30	29.1 - 50
(2) Examples 16-18	7.5 - 30	5 - 44
(3) Example 20	9	28.8
Hager et al.	2	<0
Lutter et al.	6	52

5. My invention involves developing formulations that include a chain extender as a component to adjust a glass transition temperature, or temperature sensitivity, of the viscoelastic polyurethane foam. My goal was to adjust the glass transition temperature without having to

significantly adjust or modify other major components of the formulations, i.e., isocyanate components and isocyanate-reactive components, to coincide with a use temperature, such as room temperature. Viscoelastic polyurethane foams have unique slow recovery characteristics and properties as a result of having hard segments dissolved in a soft segment phase, and the viscoelasticity is maximized when the resulting soft segment phase undergoes vitrification. This occurs when the glass transition temperature approximately coincides with ambient temperature. The subject invention achieves this goal because the presence of the chain extender manipulates the dissolved hard segments within the viscoelastic polyurethane foam, and therefore the glass transition temperature.

6. The subject invention allows for standard isocyanate components and isocyanate-reactive components comprising a flexible polyol and an EO-rich polyol to be used to form viscoelastic polyurethane foams having varying use temperatures and different temperature sensitivities by adjusting the amount of chain extender present therein. The subject invention has surprisingly determined that these unique results are obtained when the chain extender is used in amount of from 7 to 30 parts by weight based on 100 parts by weight of the viscoelastic polyurethane foam. While lower amounts of chain extenders are known, the resultant effects on the glass transition temperature when used in higher amounts was previously unexpected.

7. When a user comes into contact with the viscoelastic polyurethane foam, body heat from the user warms a portion of the viscoelastic polyurethane foam, thus softening it. The result is that the viscoelastic polyurethane foam molds to the shape of the body part in contact with the viscoelastic polyurethane foam creating a more uniform pressure distribution, which increases

comfort. In addition, the remainder of the viscoelastic polyurethane foam adjacent the warm, soft material remains relatively hard, providing support for the user. Thus, the temperature sensitivity increases the effective support factor of the viscoelastic polyurethane foam.

8. Prior to the subject invention, those of ordinary skill in the art manipulated the glass transition temperature of viscoelastic polyurethane foams by modifying or supplementing either one of the isocyanate component or the isocyanate-reactive component. Primarily, the isocyanate-reactive component was modified to achieve a specific glass transition temperature of the viscoelastic polyurethane foam. In other words, depending upon the particular uses of the viscoelastic polyurethane foam, a specific polyol component was formulated for that use. If other uses were desired that would occur at different use temperatures, then different polyol components were formulated.

9. The glass transition temperature of the viscoelastic polyurethane foam becomes significant when the articles formed from the viscoelastic polyurethane foam come into contact with a user. It is well known that viscoelastic polyurethane foams may be used as sound absorbing materials because of the unique cell structures of the viscoelastic polyurethane foam. However, when used as sound absorbing materials, the glass transition temperature is less relevant because a user does not come into contact with the article and therefore the variation of hardness with position does not result. Also, the viscoelastic polyurethane foam will act as a sound absorbing material at various temperatures.

10. It is also well known to include chain extenders in other polyurethane foams, such as

rigid and flexible polyurethane foams, polyurethane elastomers, and the like. However, none of these polyurethane foams have the unique combination of density and cell structures of viscoelastic polyurethane foams and these foams do not undergo the unique hardness variation when contacted by the user. Thus, viscoelastic properties are unique to viscoelastic polyurethane foams.

11. Additional experiments were performed by the Declarant, and in comparison with the Examples previously set forth in the above pending patent applications, to determine the effect of the presence of the chain extender. Specifically, the experiments focused on different isocyanate-reactive components and reacting the isocyanate-reactive component and the isocyanate component at different isocyanate indices.

In a first set of experiments, the amount of the chain extender and isocyanate index were varied. The base formulation for the viscoelastic polyurethane foam was as follows:

Component	Parts By Weight
Pluracol® 593 (a functionality of 2.96, a weight-average molecular weight of 3606, hydroxyl number of 460, and 75% EO-25% PO heteric)	90
Pluracol® 220 (a functionality of 3, a weight-average molecular weight of 6000, hydroxyl number of 25, and 5% EO-95% PO heteric)	10
Pluracol® 355 (a functionality of 3.96, a weight-average molecular weight of 491, hydroxyl number of 453, and 10% EO-77.9% PO)	12
Catalyst 1 (Niax® A-1)	0.25
Catalyst 2 (DABCO® 33LV)	0.1
Stabilizer (Tegostab® B-8418)	3
Monol (benzyl alcohol)	8
Water	1.43
Isocyanate No. 233/Lupranate® MI/Lupranate® M20S (48.7/31.6/19.7)	

Table 1

The isocyanate-reactive component included a blend of a flexible polyol (Pluracol® 220) and a EO-rich polyol (Pluracol® 593) and the isocyanate-reactive component also included a cross-linker (Pluracol® 355), all of which are commercially available from BASF Corporation. In the first set of experiments, the EO-rich polyol is present in a major amount, i.e., 90 parts by weight. The chain extender utilized with the first set of experiments is 1,4-butanediol.

The foams were prepared in hand-mixes using standard hand-mix techniques. In the hand mixtures, all components, except isocyanate, were added into a 64-oz. paper cup and pre-blended for 48 seconds using a 3-inch diameter circular mix blade rotating at 2200 rpm. The isocyanate component was then added and mixed for 8 seconds. The mixture was then poured into a 5-gallon bucket and allowed to cure for at least 30 minutes at room temperature. The foams were then placed into an oven set at 121 °C for 16 hours.

A dynamic mechanical thermal analysis (DMTA) was measured in accordance with D4065 using a Rheometrics RSA II. With reference to Examples 1-8, which were disclosed in the pending patent application (1), the DMTA was determined using disk-shaped samples  $\frac{3}{4}$  inch wide by  $\frac{1}{2}$  inch thick that were die cut for the measurements and at a strain of 0.5%, frequency 1 Hz and heating rate 5 °C/min were used. The DMTA provides the glass transition temperature (Tg) and peak tan delta for each of the foams.

New foam samples were prepared and tested for Examples 9-12, since the pending patent application (1) did not have examples with the chain extender present in an amount of 15 and 30 parts by weight. The DMTA was determined for the Examples 9-12 using new equipment and using disk-shaped samples 1 inch wide by  $\frac{1}{2}$  inch thick that were die cut for the measurements. The new equipment performed the DMTA tests at a strain of 0.02%, as opposed to 0.5% and at the same frequency Hz and heating rate. It is expected that the lower strain used for these examples reduces the glass transition temperature as compared to the Examples 1-8 from the pending patent application (1). As such, Examples 1-2 and 5-8 were also prepared and retested using the new machine and the different strain and the new results are set forth in Table 2 below.

Examples 1-12 were prepared by varying the amount of chain extender at two different isocyanate indices. It is to be noted that Examples 1-8 are the Examples 1-8 disclosed in Application Serial No. 10/606,825. The following table summarizes the amount of the chain extender present, the isocyanate index, and the DMTA results of each experiment.

	Chain Extender, pbw	Isocyanate Index	Application (1)		Current Samples	
			Tg, °C	Peak Tan Delta	Tg, °C	Peak Tan Delta
Ex. 1	0	90	15.6	0.95	-4.4	1.13
Ex. 2	0	95	20.3	0.91	0.2	1.05
Ex. 3	2.5	90	18.1	1.03	--	--
Ex. 4	2.5	95	22.7	0.97	--	--
Ex. 5	5	90	28.8	1.01	2.6	1.21
Ex. 6	5	95	33.9	0.93	7.6	1.05
Ex. 7	7.5	90	29.1	1.06	14.7	1.22
Ex. 8	7.5	95	31.1	0.99	15.7	1.15
Ex. 9	15	90	--	--	26.6	1.24
Ex. 10	15	95	--	--	32.4	1.11
Ex. 11	30	90	--	--	46.4	1.20
Ex. 12	30	95	--	--	50.8	1.07

Table 2

From Table 2, when the chain extender is present in smaller amounts, there is little impact on the glass transition temperature and the peak tan delta. However, when the amount of the chain extender increases, the glass transition temperature begins to increase and coincide with the use temperature of the foam. Examples 7-10 illustrate glass transition temperatures that coincide with the use temperature of the foam. When the amount of the chain extender exceeds 30 parts by weight, the foam becomes rigid and no longer exhibits viscoelastic properties. Examples 11 and 12 illustrate the glass transition temperature of 46.4 °C and 50.8 °C, whereupon foams having higher glass transition temperatures are no longer have viscoelastic properties. Comparing Examples 1 and 7, the glass transition temperature increased by 13.5 °C from the patent application (1) and 19.1°C in the current samples. Comparing Examples 2 and 8, the glass transition temperature increased by 10.8 °C and 15.5 °C, respectively.

A second set of experiments, similar to those of in Application Serial No. 10/607,555, were

conducted having a different isocyanate-reactive component than the first set of experiments. In addition to a different isocyanate-reactive component, the amount of the chain extender and isocyanate index were varied. The base formulation for the viscoelastic polyurethane foam was as follows:

Component	Parts By Weight
Pluracol® 593 (a functionality of 2.96, a weight-average molecular weight of 3606, hydroxyl number of 460, and 75% EO-25% PO heteric)	60
Pluracol® 1538 (a functionality of 2.8, a weight-average molecular weight of about 3000, hydroxyl number of 56, and 6% EO-94% PO heteric)	40
Catalyst 1 (Niax® A-1)	0.1
Catalyst 2 (DABCO® 33LV)	0.6
Stabilizer (Tegostab® B-8409)	0.4
Monol (Iconol® DA 4)	1.0
Water	1.43
Isocyanate No. 278	

Table 3

The isocyanate-reactive component included a blend of a flexible polyol (Pluracol® 1538) and a EO-rich polyol (Pluracol® 593) and the isocyanate component is Isocyanate No. 278, all of which are commercially available from BASF Corporation. In comparison to the first set, the second set of experiments has the EO-rich polyol present in lesser amounts and the flexible polyol is present in higher amounts. Additionally, the flexible polyol has a higher molecular weight than that of the first set of experiments. The chain extender utilized with the second set of experiments is Niax® DP1022.

The foams were prepared in a similar method as set forth above with regard to Examples 9-12. Further, the DMTA was measured in the same manner for these Examples and the results are

illustrated in the below table.

	Chain Extender	Isocyanate Index	Tg, °C	Peak Tan Delta
Ex. 13	0	83	-27	1.0
Ex. 14	2.5	83	-10	0.9
Ex. 15	5	83	-3	0.9
Ex. 16	7.5	83	5	1.0
Ex. 17	15	83	23	1.3
Ex. 18	30	83	44	1.6
Ex. 19	60	83	62	1.7

Table 4

From Table 4, even when a different isocyanate-reactive component is employed, the presence of the chain extender impacts the glass transition temperature and the peak tan delta. When the amount of chain extender is used in less than 7 parts by weight, the glass transition temperature does not coincide with the use temperature. However, when the amount of the chain extender increases, the glass transition temperature begins to increase and coincide with the use temperature of the foam. Example 17 illustrates the glass transition temperature that coincides with the use temperature of the foam. When the amount of the chain extender exceeds 30 parts by weight, the foam becomes rigid and loses the viscoelastic properties. Examples 18 and 19 illustrate the glass transition temperature of 44 °C and 62 °C, wherupon the foams become rigid and no longer exhibit viscoelastic properties.

A third set of data, taken from co-pending Application Serial No. 10/916,241, illustrates the subject invention when used with yet another isocyanate-reactive component.

Component	Parts By Weight
Pluracol® 593 (a functionality of 2.96, a weight-average molecular weight of 3606, hydroxyl number of 460, and 75% EO-25% PO heteric)	40
Pluracol® 2100 (a functionality of about 3, a weight-average molecular weight of about 6000, a hydroxyl number of about 25 mg KOH/g, and 5% EO-95% PO heteric)	60
Catalyst 1 (DABCO® BL-11)	0.15
Catalyst 2 (DABCO® 33LV)	0.4
Surfactant (NIAZ® Silicone L-5614)	0.15
Water	1.5
Isocyanate No. 278	

Table 5

The isocyanate-reactive component included a blend of a flexible polyol (Pluracol® 2100) and a EO-rich polyol (Pluracol® 593) and the isocyanate component is Isocyanate No. 278, all of which are commercially available from BASF Corporation. In the third set of data, the flexible polyol is added as a major component and the EO-rich polyol is present in lesser amounts. The chain extender utilized with the third experiment is Niax® DP1022.

The foams are prepared similar to those described above for Examples 1-7 as described in the pending patent application (1) and the DMTA is measured in accordance with D4065. The results of the DMTA are illustrated in the following table.

	Chain Extender	Isocyanate Index	Tg, °C	Peak Tan Delta
Ex. 20	9	87	28.8	0.61

Table 6

From Table 6, even when a different isocyanate-reactive component is employed, the presence of the chain extender in the claimed amounts results in the glass transition temperature coinciding with the use temperature.

12. I am aware of, have read, and understand the disclosure of Hager et al. (United States Patent No. 6,391,935), cited by the Examiner, which is entitled "Viscoelastic Polyurethane Foams."

13. I am also aware of, have read, and understand the disclosure of Lutter et al. (United States Patent No. 5,420,170), cited by the Examiner, which is entitled "Preparation of Flexible, Soft Polyurethane Foams Having Viscoelastic, Structure-Borne Soundproofing Properties, and Polyoxyalkylene-Polyol Mixtures which can be used for this purpose."

14. I am also aware of, have read, and understand the disclosure of Bleys (United States Patent No. 5,968,993), cited by the Examiner, which is entitled "Microcellular Elastomeric Polyurethane Foams."

15. As a result of my review of the Hager et al., Lutter et al., and Bleys and also as a result of my understanding from the perspective of one skilled in the art, it is clear that these references disclose, teach, or suggest a viscoelastic polyurethane foam having a glass transition temperature that is varied by modifying the amount the chain extender that is present or that there is suggestion or motivation to modify these references to arrive at the subject invention as claimed. Further, these foams of the cited references would not produce a viscoelastic polyurethane foam having a glass transition temperature that coincides with a use temperature. The modifications of

these references as suggested by the Examiner will not achieve my goal of adjusting the glass transition temperature without having to adjust or modify other major components of the formulations, i.e., isocyanate components and isocyanate-reactive components.

16. Hager et al.

Goals of Hager et al.

It is apparent that Hager et al. asserts that the viscoelastic polyurethane foam is produced using a unique isocyanate-reactive mixture that includes a specific monol. Further, Hager et al. states that it was surprisingly found that the monol-containing isocyanate reactive mixture *was the key* to formulating viscoelastic foams over a broad range of processing conditions and isocyanate indices.

Deficiencies of Hager et al.

Hager et al. does not disclose, teach, or suggest that the glass transition temperature, or temperature sensitivity, can be manipulated by adjusting the amount of the chain extender present in the formulation. Instead, Hager et al. focused on the presence of the monol to provide the viscoelastic foam without disclosing, teaching, or suggesting varying the glass transition temperature. In fact, Hager et al. does disclose using a chain extender; however, the chain extender is optional and is used only in minor proportions (see col. 4, lines 60-61).

Additionally, the examples disclosed in Hager et al. employ the chain extender in minor amounts. Example 16 utilizes the chain extender, 2-methyl-1,3-propanediol, in an amount of 2.0 parts by weight and Example 19 utilizes the chain extender, dipropylene glycol, in an amount of 2.0 parts by weight. Each example was formulated with an isocyanate index of 100. Since Hager et al.

is silent as to glass transition temperature for foams made in accordance with the disclosure, samples were made according to Examples 16 and 19 and the glass transition and peak tan delta were determined.

The following table sets forth the formulation used to prepare the foams. Two formulations for Examples 16 and 19 were prepared testing different monols in accordance with the disclosure of Hager et al.

Component	Parts By Weight	
	Ex. 16	Ex. 19
Pluracol® 1135 (glycerine initiated, a functionality of about 3, a weight-average molecular weight of about 1500, a hydroxyl number of about 112)	40.00	29.00
Arch Polyol G-30-168 (glycerine initiated, a hydroxyl number of about 168, All-PO)	--	29.00
Monol A (n-BuOH+PO, OH=28, 18% EO cap, CsOH catalysis)	40.00	--
Monol B (n-BuOH+PO, OH=43, 10% EO cap, CsOH catalysis)	--	40.00
Niax DP-1022	2.00	--
Diethylene glycol	--	2.00
T-9 (Stannous octoate)	0.12	0.12
Catalyst (DABCO® 33LV)	0.60	0.70
L-620 (Goldschmidt Silicone Surfactant)	0.60	0.60
FR (Flame Retardant)	3.00	3.00
Water	2.00	2.00
Isocyanate No. 278		

Table 7

Hager et al. does not disclose incorporating the isocyanate-reactive component as a blend of a flexible polyol and an EO-rich polyol. Further, Hager et al. does not disclose incorporating the chain extender in amounts used by the subject invention.

The foams were prepared in a similar manner to that described above and the DMTA was

also measured in accordance with D4065 as discussed above with regard to Example 9-12. The following table illustrates the results of the DMTA.

	Hager et al.			
	Ex. 16	Ex. 19		
Glass Transition Temperature, °C	-11	-14	-2	-3
Peak Tan Delta	0.5	0.5	0.5	0.5

Table 8

Upon inspection of these examples and in comparison to Examples 1-20 performed above, the subject invention provides that the glass transition temperature can be manipulated via the chain extender. Examples 1-4 of the subject invention have the same or lower amounts of the chain extender present and still achieve a glass transition temperature greater than those taught by Hager et al. Thus, Hager et al. merely manipulated the major components and the monol to provide the desired properties of the viscoelastic polyurethane foam without recognizing any impact on the glass transition temperature.

Accordingly, Hager et al. does not solve the problem of adjusting the glass transition temperature of the foam by adjusting the amount of the chain extender that is present in the formulation.

## 17. Lutter et al.

### Goals of Lutter et al.

It is apparent that Lutter et al. asserts that the viscoelastic polyurethane foams have a relaxation behavior that act preferentially due to a matrix of the foam. Sound waves set the matrix in vibration such that the foam requires high damping and high modulus. Lutter et al. states that good soundproofing requires a loss factor of 0.3 or more over as broad a frequency range as

possible (see col. 2, lines 36-66). This goal is achieved by using a polyoxyalkylene-polyol mixture of *specially* structured polyoxypropylene-polyoxyethylene polyols as the high-molecular weight compound (see col. 4, lines 4-9).

Deficiencies of Lutter et al.

Lutter et al. does not disclose, teach, or suggest that the glass transition temperature, or temperature sensitivity, can be manipulated by adjusting the amount of the chain extender present in the formulation. Instead, Lutter et al. states that the chain extender, if desired, is *expeditiently* used in amount from 1 to 60, preferably from 1 to 10 parts by weight per 100 parts by weight of the *specially structured* polyoxypropylene-polyoxyethylene polyols (see col. 9, lines 15-20). Moreover, Lutter et al. states that it is the novel polyoxyalkylene polyol mixture comprising the block polyoxypropylene-polyoxyethylenepolyol mixture (ai) and the difunctional and/or trifunctional polyoxypropylene/polyoxyethylene-polyol (aii) that provides viscoelastic, structure-borne soundproofing properties in a temperature range of from -20 °C to +80 °C, which is different than the glass transition temperature of the subject invention. The flexible, soft foams and moldings produced by Lutter et al. are used in the domestic sector, for example for foam backings for carpets, providing sound absorption when walked on, as paneling elements and, in the automobile industry, as structure-borne soundproofing materials, for example for enclosing the engine compartment or for reducing internal noise in vehicles by means of top layers backed with these foams (see col. 13, lines 27-43).

Lutter et al. does not disclose using a chain extender to adjust the glass transition temperature of the viscoelastic polyurethane foams. Soundproofing articles are not subjected to the same constraints as articles that form a hardness gradient when contacted by a user. Articles that

are used by users have the unique problem of needing to conform sufficiently from heat of the user, while still remaining sufficiently hard to adequately support the user. If the glass transition temperature is not consistent with the use temperature of the foam, the foam may not adequately support the user when used. For example, the foam may be too hard to too soft depending if the glass transition temperature is too high or too low, respectively.

Additionally, the examples disclosed in Lutter et al. employ the chain extender in amounts less than claimed. Examples 5 to 8 disclose the chain extender present in an amount of 6 parts by weight and the properties are listed in the following table. A sample foam was made according to the disclosure of Lutter et al. The following table sets forth the formulation used to prepare the foams.

Component	Parts By Weight
Pluracol® 593 (a functionality of 2.96, a weight-average molecular weight of 3606, hydroxyl number of 460, and 75% EO-25% PO heteric)	72.80
Pluracol® 220 ( a functionality of 3, a weight-average molecular weight of 6000, hydroxyl number of 25, and 5% EO-95% PO heteric)	18.70
1,4-butanediol	6.00
Catalyst 1 (Niax® A-1)	0.20
Catalyst 2 (DABCO® 33LV)	0.50
Polycat 5	0.10
Stabilizer (Tegostab® B-8418)	1.00
Texcat ZR-170	
Water	2.60
Lupranate® M20S	

Table 9

The foams were prepared in a similar manner to that described above and the DMTA was measured in accordance with D4065 as discussed above with regard to Example 9-12. The following table illustrates the results of the DMTA.

	Lutter et al.
Glass Transition Temperature, °C	52
Peak Tan Delta	0.4

Table 10

Upon inspection of this example and in comparison to Examples 1-20 performed above, the subject invention provides that the glass transition temperature coincides with the use temperature of the foam when the chain extender is used at the claimed amounts. Examples 1-20 of the subject invention have higher amounts of the chain extender present and have a glass transition temperature that nearly coincides with the use temperature, whereas Lutter et al. had less chain extender present and a glass transition temperature that is above those of the subject invention. As discussed above, Lutter et al. was not adjusting the glass transition temperature by manipulating the amount of the chain extender and did recognize any impact the amount of the chain extender may have on the glass transition temperature of the foam.

Accordingly, Lutter et al. does not solve the problem of adjusting the glass transition temperature of the foam by adjusting the amount of the chain extender that is present in the formulation.

#### 18. Bleys

It is apparent that Bleys discloses microcellular polyurethane elastomeric polyurethane foams having a density of less than 62.4 pounds per cubic foot and a Shore A hardness of at least 75 (see col. 3, lines 23-29). Those of ordinary skill in the art readily appreciate that microcellular elastomeric polyurethane foams do not exhibit as high of a tan delta peak as viscoelastic polyurethane foams because such elastomers do not exhibit viscoelastic characteristics. It is further

readily appreciated that viscoelastic polyurethane foams are considered flexible foams and not rigid foams. The subject invention is directed to viscoelastic polyurethane foams having a density of 2.5 to 25 pounds per cubic foot. Viscoelastic foams also have a Shore A hardness of less than 85, whereas Bleys requires a Shore A hardness of at least 85.

Accordingly, Bleys does not solve the problem of adjusting the glass transition temperature of the foam by adjusting the amount of the chain extender that is present in the formulation.

19. **Lack of Teaching or Suggestion to Adjust Temperature Sensitivity**

As one of high skill in the art, at the time of the subject invention, there was no teaching or suggestion that modifying the amount of the chain extender present in the viscoelastic polyurethane foam would vary the glass transition temperature and temperature sensitivity to accommodate specific use temperatures. The presence of the chain extenders in Hager et al., Lutter et al., and Bleys are attributable to general benefits that are well known when including chain extenders in minor amounts and are not connected with the advantages of the subject invention. As suggested by the Examiner, the chain extender in Hager et al. controls polymer build-up when present in minor amounts, without recognizing the dramatic impact on the glass transition temperature. This results because, prior to the subject invention, there was no recognition that the glass transition temperature could be so dramatically affected.

Further, since there was no teaching or suggestion of such a result in these prior art references, one of ordinary skill in the art would not have been motivated to modify the references as suggested by the Examiner.

20. Conclusion

None of the cited references disclose, teach, or suggest modifying the amount of the chain extender as claimed to vary the glass transition temperature and temperature sensitivity thereof. Further, modifying these references will not achieve my goal of adjusting the glass transition temperature without having to adjust or modify other major components of the formulations, i.e., isocyanate components and isocyanate-reactive components. In other words, my goal to provide a solution to requiring designer isocyanate-reactive components for achieving viscoelastic polyurethane foams with varying glass transition temperatures that coincide with use temperatures has not been satisfied through these references.

21. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information are believed to be true, and further that these statements were made with the knowledge that willful and false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or patent issued thereon.

Respectfully submitted,

Dated 5/30/00

Raymond Neff

Raymond Neff

**RELATED PROCEEDINGS APPENDIX**

NONE